IMMEDIATE EFFECT OF FLUTTER ON PULMONARY FUNCTION IN PATIENTS WITH CHRONIC BRONCHITIS

-An Experimental Study

Dissertation submitted to The Tamil Nadu Dr. M.G.R. Medical University towards partial fulfilment of the requirements of **MASTER OF PHYSIOTHERAPY (Advanced PT in Cardio - Pulmonary Diseases)** Degree programme.

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CERTIFICATE

This is to certify that the research work entitled "**IMMEDIATE EFFECT OF FLUTTER ON PULMONARY FUNCTION IN PATIENTS WITH CHRONIC BRONCHITIS"-An Experimental Study,** was carried out by the candidate bearing the **Register No. 27091614,** KMCH College of Physiotherapy, towards partial fulfilment of the requirements of **Master of Physiotherapy (Advanced PT in Cardio-Pulmonary Diseases)** degree course under, The Tamil Nadu Dr. M.G.R. Medical University, Chennai - 32.

PROJECT GUIDE

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INTERNAL EXAMINER

EXTERNAL EXAMINER

Dissertation Evaluated on:

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CONTENTS

ABSTRACT

AIM: To study the immediate effect of flutter on pulmonary function in patients with chronic bronchitis. **OBJECTIVE:** To find out the immediate effect of flutter along with conventional physiotherapy on pulmonary function in chronic bronchitis patients. **STUDY DESIGN:** Pre test- Post test experimental study design. **METHODOLOGY:** 30 patients with chronic bronchitis were selected through purposive sampling method for the study and were assigned in two groups. Group A consisting of 15 patients were treated with conventional physiotherapy where as group B consisting of 15 patients were treated with flutter along with conventional physiotherapy. **OUTCOME MEASURES:** Pre- test, post-test measurement using computerized pulmonary function test was done. The values of FEV_1 and MVV were taken. **RESULTS:** The data were analyzed using paired‘t’ test and independent‘t’ test. With paired‘t’ test there is a significant difference in FEV_1 and MVV values within the pre test and post test values of both the groups. But by using independent‘t’ test, the analysis at 5% level of significance denotes that there is no significant difference in FEV_1 and significant difference in MVV between the groups. **CONCLUSION:** From the results it can be concluded that flutter has immediate effect on pulmonary function in chronic bronchitis patients.

KEYWORDS:

COPD- Chronic Obstructive Pulmonary Disease

FEV_1- Forced Expiratory Volume in 1 second

MVV- Maximum Voluntary Ventilation

PFT- Pulmonary Function Test

CPT- Chest Physical Therapy

1. INTRODUCTION

Chronic Obstructive Pulmonary Disease is one of the leading causes of morbidity and mortality. It affects about 4 -10% of the global population.[20] World Health Organization estimates that COPD causes 4.7 million deaths annually which makes it as the fifth leading cause of global mortality.[47]

Global initiative of chronic obstructive lung disease (GOLD) defined Chronic Obstructive Pulmonary Disease as "a disease state characterized bronchitis is one of the physiological entities comprising COPD". [16, 17]

Chronic bronchitis has been defined as a disorder in which a patient's cough is productive of sputum for 3 months for at least 2 consecutive years[34].

Smoking is the main cause for chronic bronchitis.[41]

Chronic obstructive lung diseases are characterized by some degree of chronic airflow limitation, or increased secretions, bronchospasm, inflammation or destruction of the bronchial walls.

The increased airflow limitation is not fully reversible. Airflow limitation is usually progressive and also associated with an abnormal inflammatory response of the lung to the noxious particles or gases".

Airway mucus hyper secretion is a cardinal feature of COPD. Mucus hyper secretion is associated with goblet cell hyperplasia and sub mucosal gland hypertrophy.

The number of ciliated cells and ciliary length is decreased in patients with chronic bronchitis.

Coughing is the hallmark symptom of chronic bronchitis. The cough begins slowly and worsens insidiously but steadily until there is mucous production.

The course of chronic bronchitis is characterized by respiratory infections during which severe coughing, dyspnea, production of purulent secretions and aberration in pulmonary gas exchange may require hospitalization. Prolonged expiratory wheezes, and crackles during expiration, cyanosis and pulmonary edema are the classical physical features of the patient with chronic bronchitis.[34]

In addition to their chronic disease patients with COPD experience regular acute exacerbation. Management given to patients with COPD includes medication & Physiotherapy. The main goal of treatment is to maintain bronchial hygiene and improve the pulmonary function.

Physical therapy interventions used are breathing exercise, Postural drainage, Autogenic drainage, Active cycle of breathing, Chest expansion exercise and Relaxation techniques.

The conventional physiotherapy consists of Diaphragmatic breathing exercise, Coughing technique, & segmental breathing.[14]

Flutter is a simple hand held apparatus that promotes the clearance of sputum from the lungs.

The flutter as a device to clear mucus is based on its ability to vibrate the airways, intermittently increase endobronchial pressure, and accelerate expiratory airflow.

The efficacy of the flutter in facilitating mucus clearance in Cystic fibrosis has been resorted.[24]

The purpose of this study is to find the immediate effect of flutter device combined with conventional physiotherapy on pulmonary function in chronic bronchitis patients.

1.1. NEED FOR THE STUDY

Secretion removal plays an important role in physiotherapy management of COPD.

There are various airway clearance techniques like postural drainage, autogenic drainage, active cycle of breathing, expiration with glottis open in the lateral posture, coughing technique etc.

More studies were conducted to compare the combined effect of flutter along with other airway clearance techniques on pulmonary function in COPD patients.

Konstan et al have compared 3 regimens flutter, voluntary coughing and postural drainage which included up to 10 positions. Each session lasted for 15 minutes. He reported that up to 3 regimens more sputum was expectorated with the flutter than other.[23]

Ambrosino et al stated that flutter to be as effective as active cycle of breathing.[2]

Lindemann compared autogenic drainage with the flutter and concluded that both regimens were equally effective, but the flutter was easier to teach.[25]

But only fewer studies were conducted to find the immediate effect on pulmonary function using flutter alone to mobilize the secretions.

The aim of this study is to find the immediate effect of flutter on pulmonary function in chronic bronchitis patients.

2. REVIEW OF LITERATURE

2.1. INTRODUCTION

Chronic obstructive pulmonary disease is one of the common respiratory problems & airway secretion is one of the most important components of COPD. Epidemiological evidences say that the mortality of COPD is high, with an estimated rate of 48 per 10,000 in men & 18.8 per 10,000 in women. COPD accounts about 6.4% of all male deaths and 3.9% of all female deaths.

Smoking is the main causative factor the incidence of COPD is more in males than females.[27]

2.2. PATHOLOGY

According to **Bellone A et al** Chronic obstructive lung diseases are characterized by some degree of chronic airflow limitation, or increased secretions, bronchospasm, inflammation or destruction of the bronchial walls.

The increased airflow limitation is not fully reversible. Airflow limitation is usually progressive and also associated with an abnormal inflammatory response of the lung to the noxious particles or gases". [5]

King M insisted that mucus hyper secretion is associated with goblet cell hyperplasia and sub mucosal gland hypertrophy.[23]

Rubin BK said that the number of ciliated cells and ciliary length is decreased in patients with chronic bronchitis.[23]

2.3. CLINICAL FEATURES

Jan Stephen Tecklin highlighted that coughing is the hallmark symptom of chronic bronchitis. The cough begins slowly and worsens insidiously but steadily until there is mucous production.

The course of chronic bronchitis is characterized by respiratory infections during which severe coughing, dyspnea, production of purulent secretions and aberration in pulmonary gas exchange may require hospitalization. Prolonged expiratory wheezes, and crackles during expiration, cyanosis and pulmonary edema are the classical physical features of the patient with chronic bronchitis.[34]

2.4. CHEST PHYSICAL THERAPY

Scott Irwin et al suggested that chronic obstruction of the airways can be caused by increased secretions, bronchospasm, inflammation or destruction of the bronchial wall or combination of all. There is an interference of the normal flow of air within the lungs and some reversibility of the obstructive components can be achieved through the use of bronchodilator and chest physical therapy.[34]

Pryor et al found out that the effectiveness of various physical therapy measures for adults in patients with COPD patients.[31]

Craig L.Scanlan et al stated that chest physical therapy has been shown effective in aiding secretion clearance and improving pulmonary function in COPD associated with copious sputum production.[13]

Health care professionals provide pulmonary rehabilitation as a preventive health care program which helps to keep people physically, psychologically & socially active with the diseases.[15]

2.4.1. FLUTTER

Flutter is a device that uses oscillating positive expiratory pressure that varies from 10 to 20 cm H_2O. The device creates a self regulated oscillating positive pressure, due to a steel ball, with oscillation of the airflow.[1]

Konstan et al [1994] have compared three regimens FLUTTER, voluntary coughing and postural drainage which included up to ten positions. Each session lasted for 15 minutes. He reported that up to three regimens more sputum was expectorated with the flutter than with other.

The average amount of sputum expectorated with the flutter was over four times the amount expectorated after conventional postural drainage with percussion and vibration.[1, 24]

Lindemann [1992] compared autogenic drainage with the flutter and concluded that both regimens were equally effective, but flutter was easier to teach.[25]

Burioka N, Sugimoto Y et al [1998], concluded that the use of flutter was effective in clearing mucus from the airways.[7]

Chatham et al [1993], told that use of the flutter in airway clearance may improve compliance in some patients, especially children.[26]

Pryor et al [1994], suggested that flutter to be less effective than active cycle of breathing (ACBT).[32]

Smith D.L. and Harrison [1994], conducted prospective randomized clinical trial using flutter as an adjunct to chest physical therapy in cystic fibrosis. The result of the study suggested that using flutter as an adjunct to physiotherapy had no significant changes in lung function or oxygenation.[32]

Ambrosino et al [1995], stated that flutter to be as effective as the active cycle of breathing.[2]

Carolyn C.Campo et al [1996] said that flutter appears to be equally as effective as CPT when used as bronchial hygiene therapy for the promotion of sputum mobilization and improved breath sounds.[8]

Homnick D.N, Marks M.H, Anderson K [1998],compared the efficacy and safety of the flutter device to standard, manual chest physiotherapy in

hospitalized patients with cystic fibrosis consisting of 22 patients who performed flutter 4 times per day. He concluded that flutter appears to be a useful device for independent, cost effective and administration.[21]

Nakamura.S et al [1996], concluded that use of the flutter can increase the expectoration of sputum & can relieve related symptoms.[29]

Van Winden et al [1998] conducted a crossover randomized study comparing the effects of flutter and PEP mask physiotherapy on symptoms & lung function in children with cystic fibrosis consisting of 22 children who performed physiotherapy using either flutter or PEP mask twice a day for 2 weeks. He concluded that there was no significant difference found between the two techniques.[42]

Sharon MH et al [2003], conducted a pilot study comparing the effect of postural drainage or flutter device in conjunction with breathing and coughing with breathing & coughing alone in improving secretion removal and lung function in patients with acute exacerbation of bronchiectasis, suggested that there was no difference in sputum production or lung function parameters among the three groups.[38]

Raschi S, Andrea Bellone et al [2000], did a prospective randomized study on 3 forms of chest physical therapy including postural drainage, flutter &

ELTGOL. He concluded that all 3 treatments were effective in patients with acute exacerbation of chronic bronchitis.[5]

CS Thompson [2002], conducted a randomized cross over study of flutter device and the active cycle of breathing technique in non-cystic fibrosis, bronchiectasis and has concluded that both techniques were equally effective.[39]

He stated that daily use of the flutter device in the home is an effective as ACBT in patients with non- cystic fibrosis, bronchiectasis & high level of patient acceptability.[39]

Weiner P et al [1996], concluded that long- term home physiotherapy with the flutter was effective in COPD in improving airflow, ability & symptoms.[44]

Wolkove N et al [2004], stated that flutter appeared to be equally as effective as conventional manual chest therapy (CPT) when used as bronchial hygiene therapy for the promotion of sputum mobilization and improved breath sounds.[46]

Brooks D et al [2002], demonstrated that there was positive incline and a large airflow response in an increase in expiratory procedure with flutter.[6]

Raschi S[1994], et al compared Short term effect of postural drainage ,flutter & ELTGOL in acute exacerbation of chronic bronchitis and concluded that all the treatments were safe & effective in removing secretion causing

undesirable effect on oxygen saturation but flutter & ELTGOL techniques were more effective in secretion.[5]

Retzow A, **Cegla et al [1993],** concluded that flutter in addition to promoting mucus expectoration, also improves pulmonary function in patients with obstructive lung disease.[11]

Nixon PA et al [1999], demonstrated that patients using the flutter device had better pulmonary function after 1 week of therapy and similar improvement in pulmonary function & exercise tolerance compared to chest physical therapy after 2 weeks of treatment, suggesting that flutter valve therapy is an acceptable alternative to standing chest physical therapy in hospital care of patients with cystic fibrosis.[18]

Balgburm M [1995], found flutter to be 3 times more effective in increasing sputum expectoration as traditional drainage & chest clapping.[3]

Pike SE et al [1999], stated that inclusion of the forced expiratory maneuver in the regimen would likely to increase the effectiveness of airway clearance.[30]

Sahl W et al (1989) compared flutter with the PEP mask, the flutter showed a small increase in spirometry values, whereas PEP mask did not, but the two techniques were otherwise comparable.[12]

2.4.2. DIAPHRAGMATIC BREATHING EXERCISE

Jennifer A Pryor reported that breathing control is normal tidal breathing using lower chest with relaxation of upper chest and shoulder.[32]

Nancy Humberstone and Jan Stephen Tecklin suggested that deep breathing exercise is traditionally performed to increase ventilation. It alleviates dyspnea and reduces post operative complications.[34]

Carolyn Kisner suggested that deep breathing exercise are designed to improve the efficacy of ventilation, reduce the work of breathing and improve gas exchange and oxygenation.[9]

Vitacca M ,Ambrosino N,Clini E[1998], concluded that in severe obstructive pulmonary disease patients with chronic hypercapnia, deep diaphragmatic breathing was associated with improvement of blood gases at the expense of a greater inspiratory muscle loading.[43]

Anderson .J.M, Innocenti D.M, said that breathing exercises are useful for assisting in the removal of secretions and improving movement of the thoracic cage.

Craig L.Scanlan said that patients with chronic obstructive pulmonary disease, diaphragmatic breathing exercise had been shown to increase the relative contribution of this muscle to ventilation from about 40% to about 67%.

Lateral costal breathing exercises increases mobility of the diaphragm and increases ventilation to the lung bases.[13]

2.4.3. COUHING TECHNIQUE:

Jan Stephen Tecklin et al suggested that coughing is very effective in removing secretion.[34]

Susan B O'Sullivan, Thomas J Schmitz et al said that coughing is the most common and easiest means of clearing the airway. High intrathoracic pressure, such as those generated during coughing, can force the closing of small airways in some patients. Coughing allows the patient to remove secretions.[36]

Joanne Watchie et al mentioned the effectiveness of coughing techniques as changes in oxygen saturation, improvements in breath sounds, increases in expiratory flow rate and reduction in the patient's level of dyspnea and assist in removal of secretions from the airway.[22]

Rossman CM et al [1982], concluded that in cystic fibrosis, cough session may be as effective as therapist- administered physiotherapy in removing pulmonary secretions. Frequent, vigorous self- directed cough sessions are useful as more complex measures for effective bronchial hygiene.[33]

2.5. PULMONARY FUNCTION TEST

Watchie stated that FEV_1 and MVV measure pulmonary function and both will be reduced in COPD.[22]

2.6. SUMMARY:

The review of literature gives a clear idea about the development of airway clearance techniques in COPD. In recent years the effect of many techniques like Active cycle of breathing, Autogenic drainage, ELTGOL, Postural drainage and other techniques were compared with Flutter in COPD patients. There were only limited studies in investigating the short-term effect of flutter in COPD. Thus this study is designed to find out the immediate effect of flutter on pulmonary function in patients with chronic bronchitis.

3. AIM AND OBJECTIVES

3.1. AIM:

To study the immediate effect of flutter device on pulmonary function in patients with chronic bronchitis.

3.2. OBJECTIVES:

1. To find out the immediate effect of conventional physiotherapy on pulmonary function in chronic bronchitis patients.
2. To find out the immediate effect of flutter along with conventional physiotherapy on pulmonary function in chronic bronchitis patients.
3. To improve the pulmonary function.

4. MATERIALS AND METHODOLOGY

4.1. STUDY DESIGN

Pre test - post test experimental study design.

4.2. STUDY SETTING

Department of Physical Medicine & Rehabilitation,

Kovai Medical Center & Hospital,

Coimbatore.

4.3. SAMPLE TECHNIQUE

Purposive sampling technique

4.4. SAMPLE SIZE

30 patients

Group A: 15 subjects (conventional physiotherapy)

Group B: 15 subjects (flutter along with conventional physiotherapy).

4.5. SELECTION CRITERIA:

4.5.1. Inclusion Criteria

- Chronic bronchitis patient who are on regular medication.
- Sex: Males & Females
- Age: between 40 – 60 years.
- BMI: 20-25 .
- FEV1: 50% - 80% predicted.

4.5.2. Exclusion criteria

- Patients with restrictive lung disease
- Asthma
- Cardiac diseases like cardiac failure, myocardial infarction etc.,
- Neurological deficits
- Pulmonary Tuberculosis
- Patients who has undergone recent thoracic & abdominal surgeries.
- Cystic fibrosis
- Rib fracture
- Un- cooperative patient.

4.6. HYPOTHESIS

4.6.1. NULL HYPOTHESIS

H_{01}: There is no significant immediate effect of conventional physiotherapy on pulmonary function in chronic bronchitis patients.

H_{02}: There is no significant immediate effect of conventional physiotherapy along with flutter on pulmonary function in chronic bronchitis patients.

H_{03}: There is no significant difference between conventional physiotherapy and conventional physiotherapy along with flutter on pulmonary function in chronic bronchitis patients.

4.6.2. ALTERNATE HYPOTHESIS

H_{A1}: There is a significant immediate effect of conventional physiotherapy on pulmonary function in chronic bronchitis patients.

H_{A2}: There is a significant immediate effect of conventional physiotherapy along with flutter on pulmonary function in chronic bronchitis patients.

H_{A3}: There is a significant difference between conventional physiotherapy and conventional physiotherapy along with flutter on pulmonary function in chronic bronchitis patients.

4.7. STUDY METHOD

PROCEDURE:

4.7.1. GROUP A: CONVENTIONAL PHYSIOTHERAPY

[Diaphragmatic Breathing Exercise, Segmental breathing, coughing technique,]

- **Diaphragmatic breathing exercise:**

The technique for diaphragmatic breathing exercise is as follows:

- The patient should be in a relaxed and comfortable position.
- Therapist hand is placed on rectus abdominis just below the anterior costal margin.
- Patient is asked to breathe in slowly & deeply through the nose with relaxed shoulders and patient is asked to hold for 3-5 sec.
- Then the patient is asked to place his or her own hand below the anterior costal margin and asked to feel the movement.
- Patient is advised that the placed hand should rise during inspiration and fall during expiration.

Sessions: 1 session / day.

Repetition: 10 repetitions/ session.

Duration: 10-15 min.

DIAPHRAGMATIC BREATHING EXERCISE

ᔓ Segmental breathing:

Lateral costal expansion:

- The patient is positioned in sitting or semi-fowlers position.
- The patient is asked to place the hands along the lateral aspect of the lower ribs to fix the attention to the areas at which the movement is to occur.
- The patient is asked to breathe out to feel the rib cage move downward and inward.
- Placing the hands over rib area increases sensory awareness as the patient breathes into the IRV and the chest expands and ribs flare.

LATERAL COSTAL EXPANSION EXERCISE

Posterior basal expansion:

- The patient is positioned in sitting and lean forward on a pillow, slightly bending the hips.
- The patient is asked to perform the same maneuver, by placing hands on posterior aspects of lower ribs.

Repetition: 2 sets of 5 repetitions are given.

Duration: 10 minutes.

Coughing technique:

- The patient is placed in a relaxed and comfortable position. Sitting or forward leaning is usually the best recommended position for coughing.
- The patient's neck is slightly flexed to make coughing more comfortable.
- The patient is taught controlled diaphragmatic breathing, emphasizing deep inspiration.
- A sharp, deep, double cough and the proper muscle action of coughing [contraction of the abdominals] are demonstrated.
- The patient is instructed to place his/her hands on the abdomen and to make three huffs with expiration and feel the contracting abdominals.
- The patient is taught to make a 'k' sound to experience tightening the vocal cords, closing the glottis, and contracting the abdominals.

- When the patient has put these actions together, he/she is instructed to take a deep but relaxed inspiration, followed by a sharp double cough. In a single expiration, the second cough is more productive.

4.7.2. GROUP B: CONVENTIONAL PHYSIOTHERAPY ALONG WITH FLUTTER

- The patient is asked to sit in a comfortable upright sitting position with elbow support on a table and neck slightly extended in order to open up the airway.
- In order to get a maximal oscillatory effort the flutter device is held in the mouth horizontally and tilted slightly upwards.
- Inspiration is done through the nose. A slow breath in, slightly deeper than normal with a breath hold of 3-5 seconds followed by breath out through the flutter device in a slightly faster rate than normal.
- After 4-8 of these breaths, a deep breath with a ‘hold’ at full inspiration is followed by a forced expiration through the flutter device. This precipitates expectoration and is followed by a pause for breathing control, and then according to the subjects’ preference a cough or huff is done.
- The upward movement of the flutter increases the pressure and frequency, while movement of the device downward results in lower pressure and

frequency. While doing the procedure the patient should keep the cheeks flat and use the abdominal muscles to produce effective exhalation.

- The vibration of the chest is palpated by the patient to provide feedback as to the device. A flutter session lasts 15 minutes.
- To avoid dizziness due to hyperventilation, a patient should refrain from forced exhalation. It may be necessary to have a pause every 5-10 exhalations before resuming the session.

Treatment time: 10-15 minutes.

PULMONARY FUNCTION TEST

FLUTTER

4.8. MEASUREMENT TOOLS

- Computerized Pulmonary Function Test was used to find the

  -Forced Expiratory Volume in 1 second [FEV_1]

  -Maximum voluntary ventilation [MVV].

Outcome measures are measured before and after treatment.

4.9. STATISTICAL ANALYSIS

Pre-test and Post-test values of the study are collected and assessed for variation in improvement & their results were analyzed using Independent `t' test and Paired `t' test.

4.9.1. PAIRED `t' TEST (within groups)

$$t = \frac{\bar{d}\sqrt{n}}{S}$$

Where,

$$S = \sqrt{\frac{\sum \boldsymbol{d^2} - \left[\overline{\boldsymbol{d}}\right]^{\boldsymbol{2}} \times \boldsymbol{n}}{\boldsymbol{n-1}}}$$

4.9.2. INDEPENDENT `t' TEST (between groups)

$$t = \frac{\overline{X1} - \overline{X2}}{S} \sqrt{\frac{n_1 n_2}{(n_1 + n_2)}}$$

Where,

$$S = \sqrt{\frac{\sum d_1^2 + \sum d_2^2}{n_1 + n_2 - 2}}$$

S= combined standard deviation

d_1&d_2 = difference between initial & final readings in group A &group B respectively.

n_1&n_2= number of patients in group A & group B respectively.

$\overline{X}_1$&$\overline{X_2}$ = Mean of group A & group B respectively.

Level of significance: 5%

5. DATA PRESENTATION

5.1. TABULAR PRESENTATION:

Paired‘t’ test

Table I: - FEV_1

GROUP A

Mean values [%]	**Pre-test**	**Post-test**
	61.22	64.14
Calculated ‘t’ value	2.69	
p value and level of significance	p < 0.05 and significant	

GROUP B

Mean values [%]	**Pre-test**	**Post-test**
	62.92	67.55
Calculated ‘t’ value	3.00	
p value and level of significance	p < 0.05 and significant	

Table II:- MVV

GROUP A

Mean values [%]	**Pre-test**	**Post-test**
	13.44	15.6
Calculated 't' value	3.83	
p value and level of significance	$p < 0.05$ and significant	

GROUP B

Mean values [%]	**Pre-test**	**Post-test**
	17.51	20.92
Calculated 't' value	3.91	
p value and level of significance	$p < 0.05$ and significant	

INDEPENDENT‘t’ TEST

Table III: - FEV_1

		Mean Values [%]	Calculated ‘t’ value	p value and level of significance
Pre-test	Group A	61.22	0.47	p >0.05 and not significant
	Group B	62.92		
Post-test	Group A	64.14	1	p > 0.05 and not significant
	Group B	67.53		

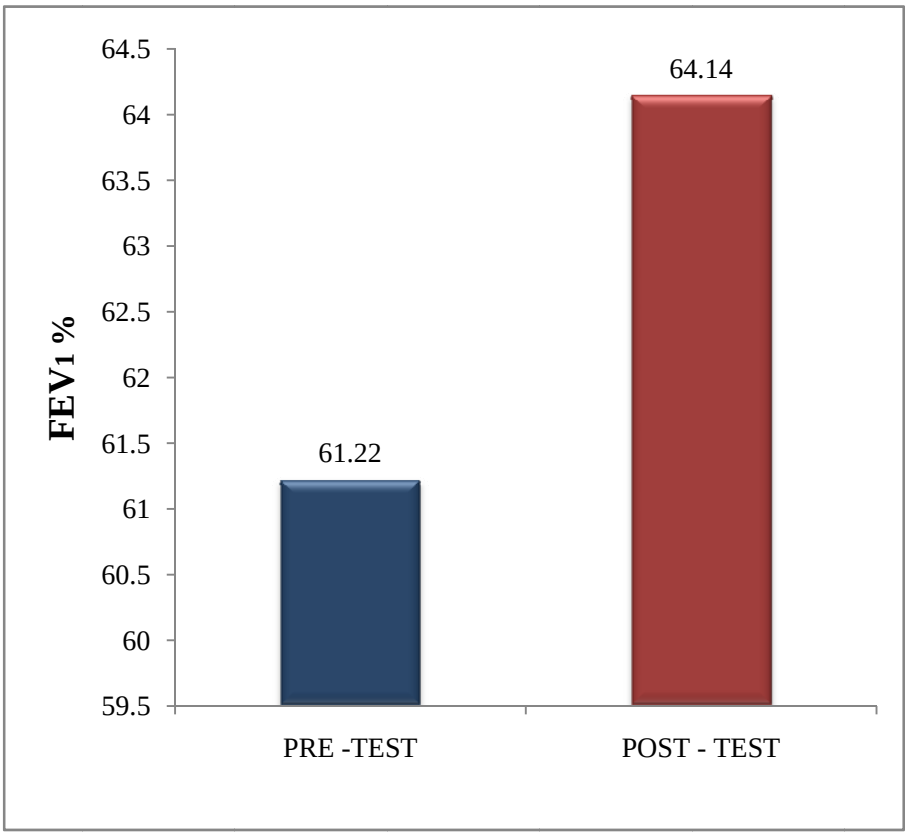
Table IV:- MVV

		Mean Values [%]	**Calculated 't' value**	**p value and level of significance**
Pre-test	Group A	14.24	1.358	$p > 0.05$ and not significant
	Group B	16.07		
Post-test	Group A	15.46	2.77	$p < 0.05$ and significant
	Group B	20.9		

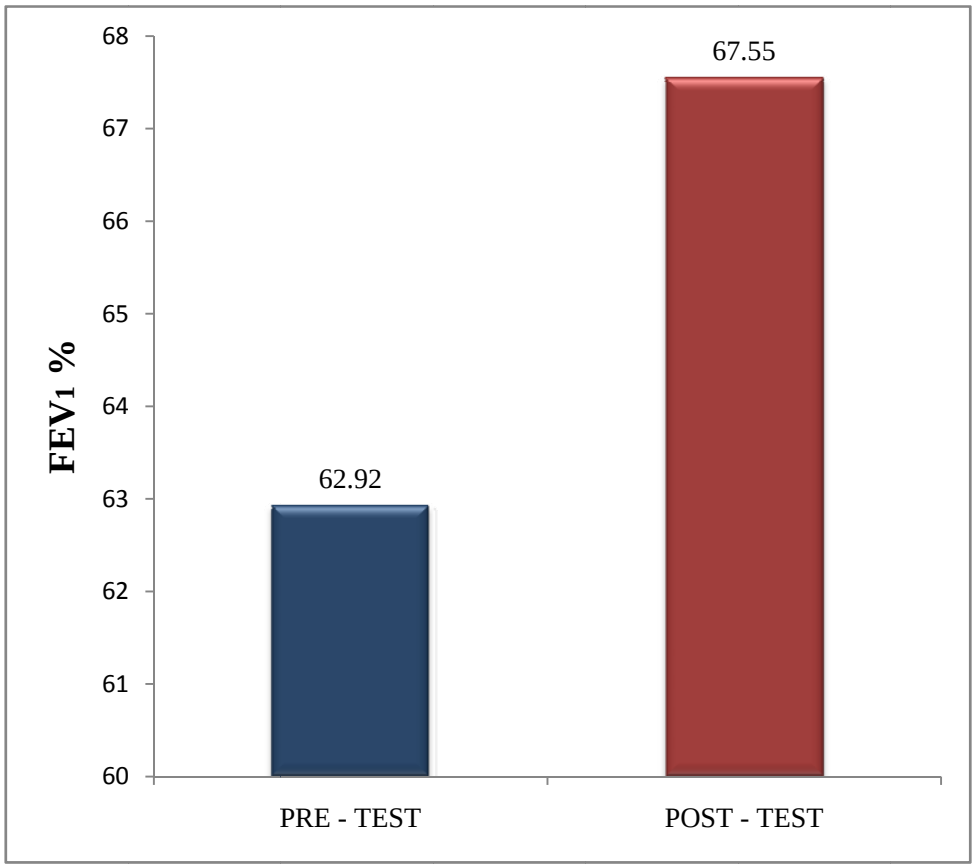
5.2. GRAPHICAL PRESENTATION

Graph I: - FEV1

CONTROL GROUP – GROUP A

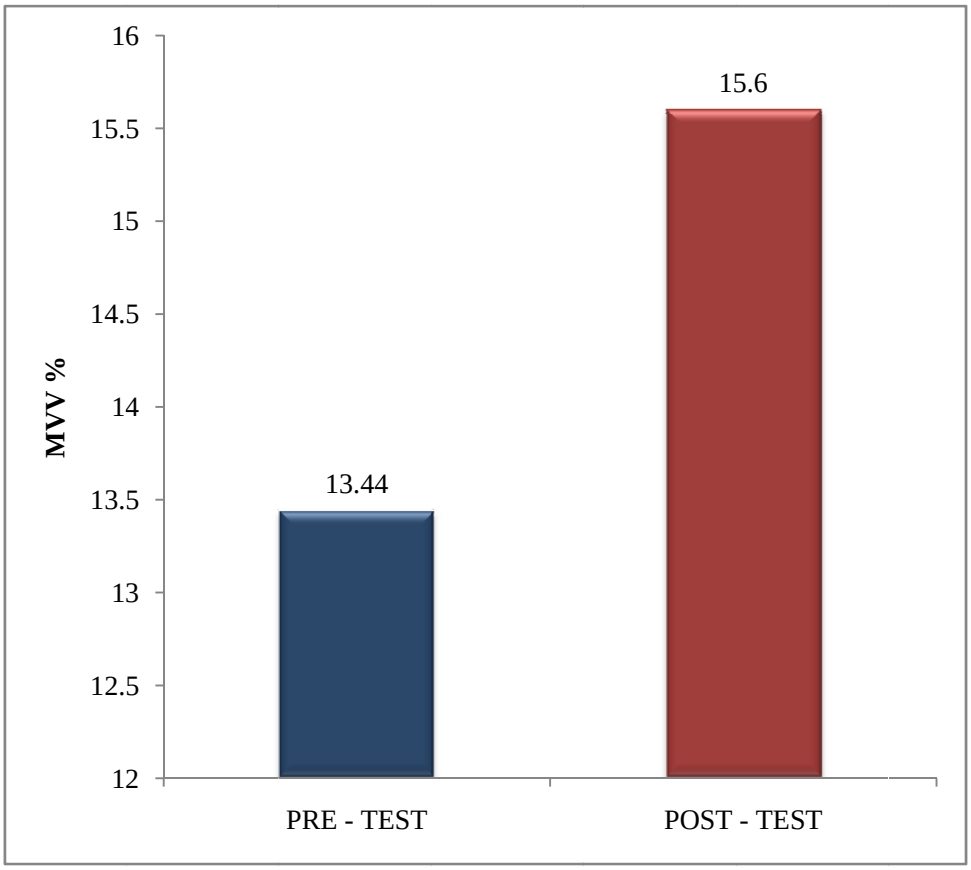


EXPERIMENTAL GROUP – GROUP B

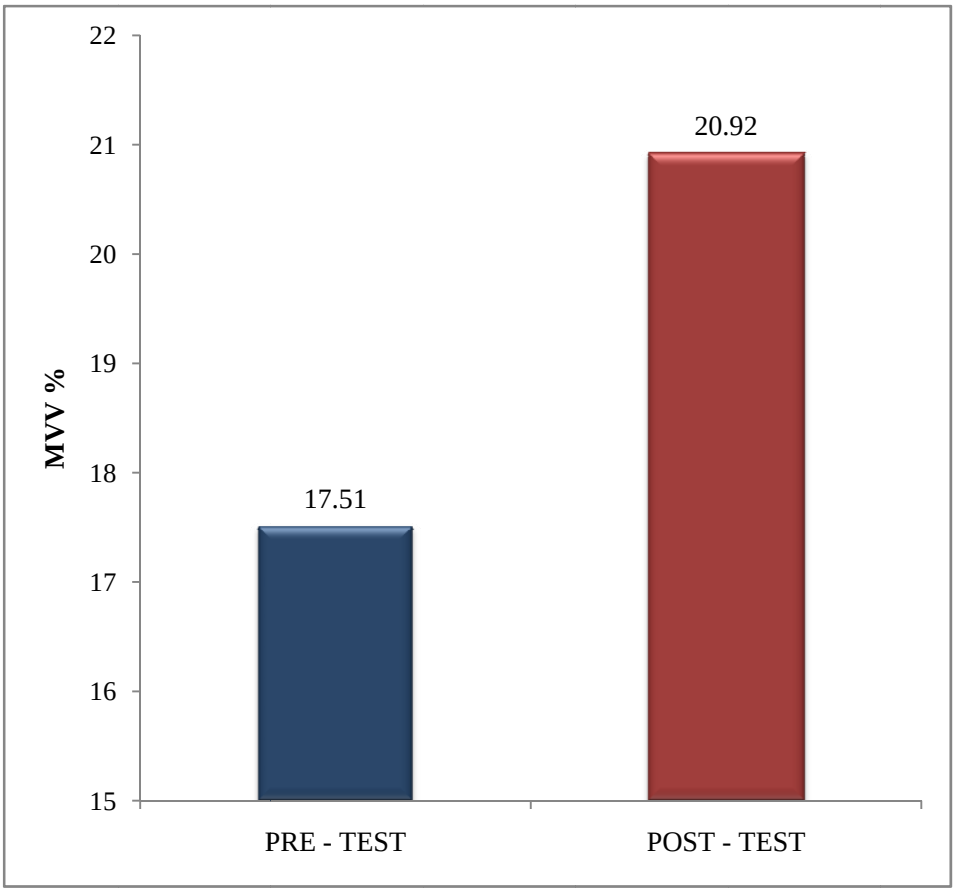


MVV

CONTROL GROUP - GROUP A

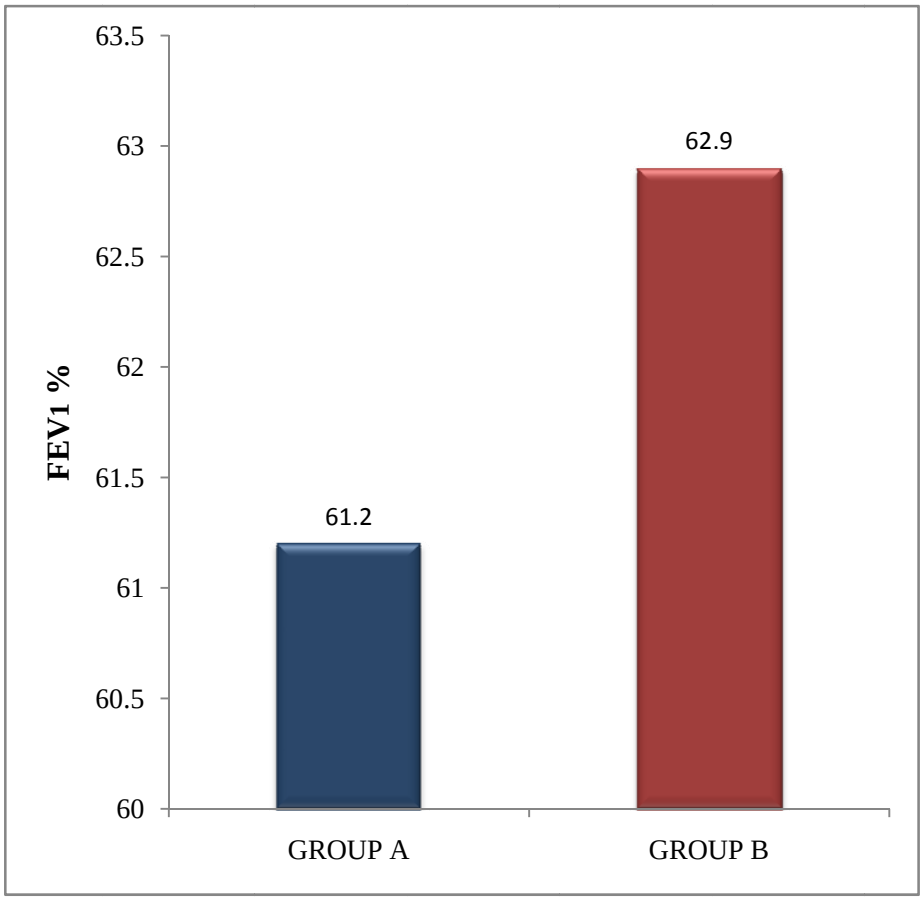


EXPERIMENTAL GROUP - GROUP B

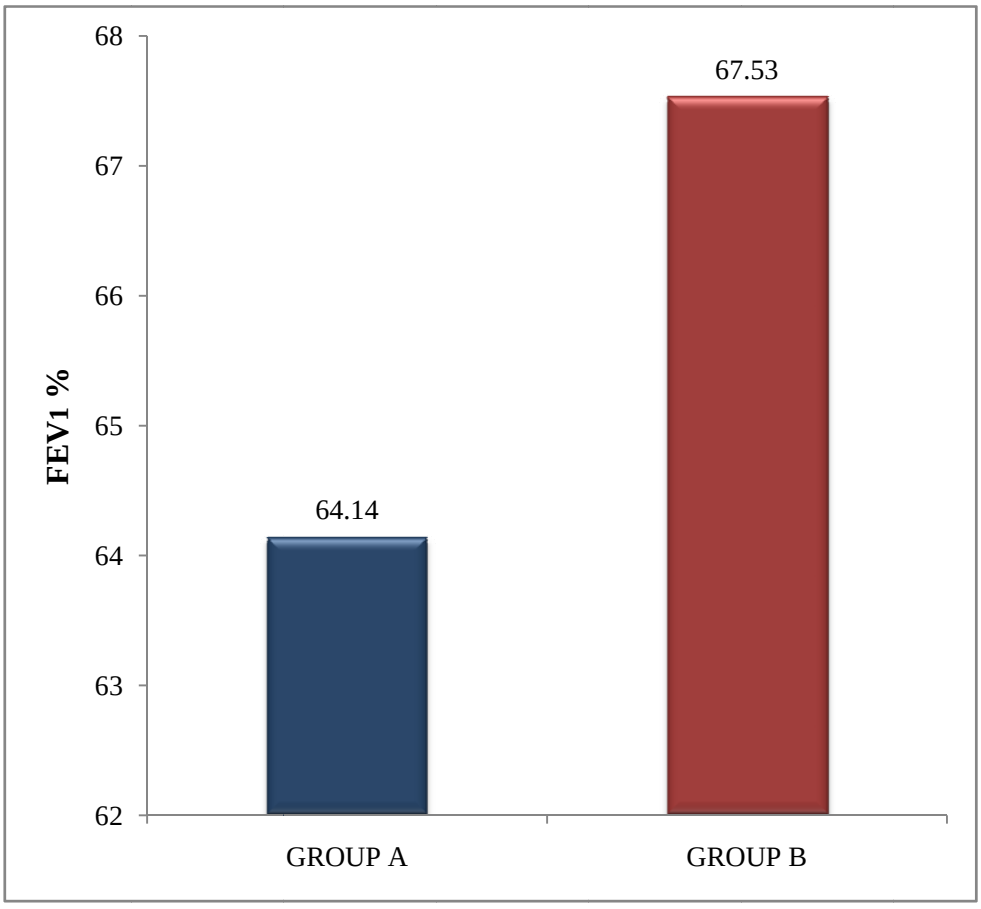


FEV1

PRE – TEST

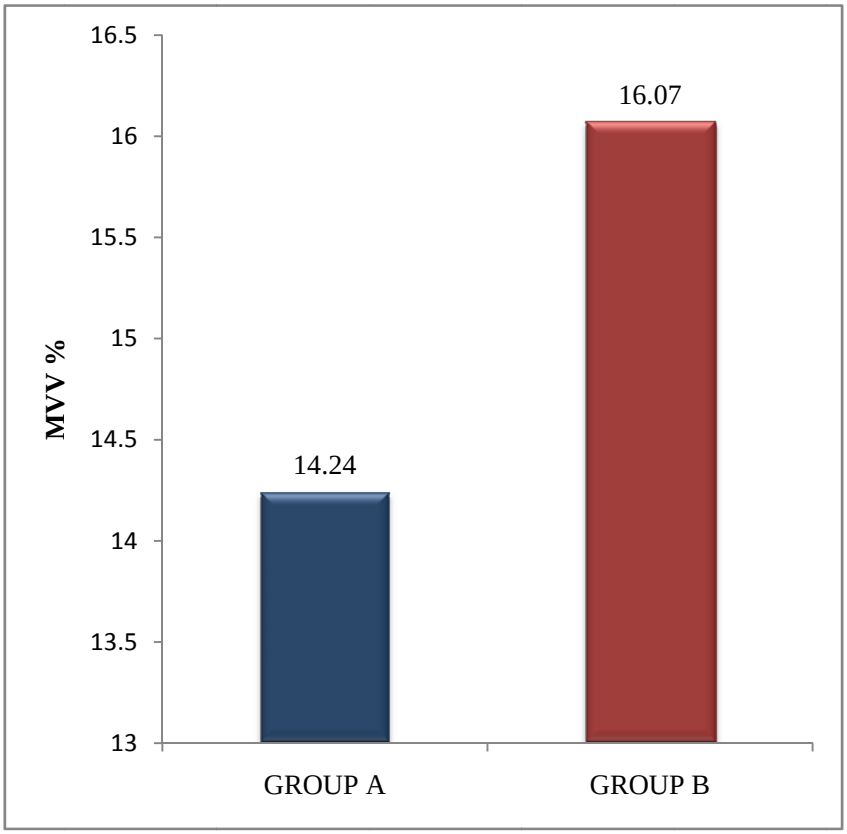


POST – TEST

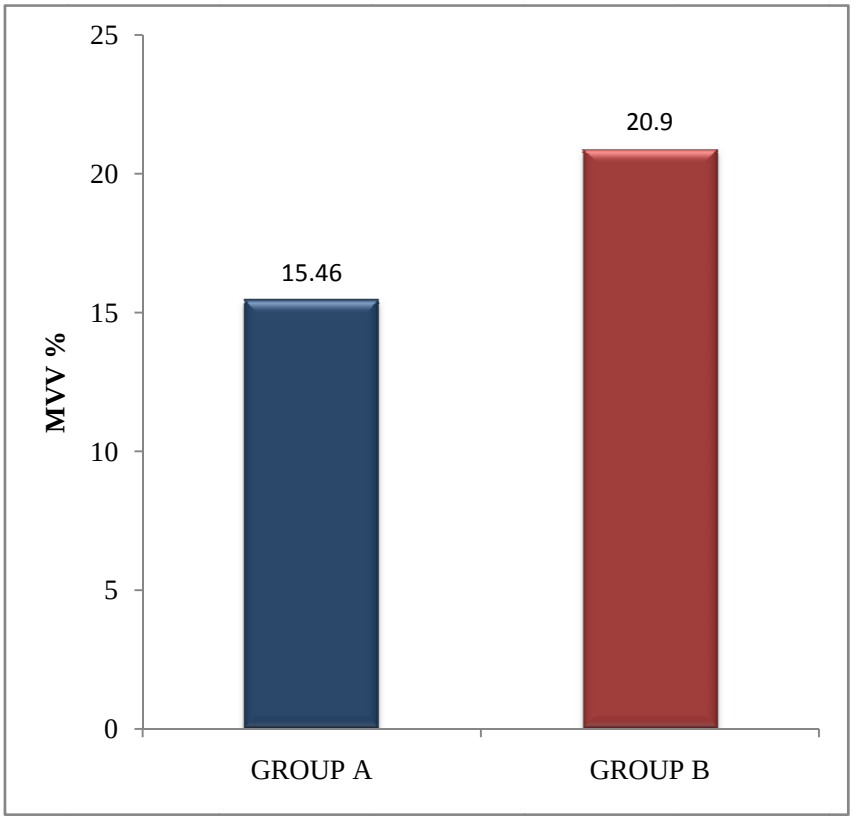


MVV

PRE – TEST



POST – TEST



6. DATA ANALYSIS AND INTERPRETATION

The changes within the group were analyzed using paired‘t’ test and the difference between the groups were analyzed using independent‘t’ test.

- **FEV_1**
  - Pre-test

When the pre-test values of group A and group B were analyzed by independent‘t’ test the calculated‘t’ value is 0.47. The table‘t’ value at 5% level of significance for 28 degrees of freedom is 1.711, which is greater than the calculated ‘t’ value. Hence no significant difference is found between the groups.

- Group A

When the pre-test and post-test values were analyzed by paired‘t’ test, the calculated‘t’ value is 2.69. For 14 degrees of freedom at 5% level of significance the table‘t’ value is 1.761. Since the calculated‘t’ value is greater than the table‘t’ value, the null hypothesis is rejected.

- Group B

When the pre-test and post-test values were analyzed by paired‘t’ test, the calculated‘t’ value is 3.00. For 14 degrees of freedom at 5% level of significance the table‘t’ value is 1.761. Since the calculated‘t’ value is greater than the table‘t’ value, the null hypothesis is rejected.

- Post-test

The table‘t’ value for 28 degrees of freedom at 5% level of significance is 1.711. The values are analyzed by independent‘t’ test. The calculated‘t’ value is 1.00, which is lesser than the table‘t’ value. Hence no significant difference is found between the groups.

- **MVV**
  - Pre-test

When the pre-test values of group A and group B were analyzed by independent‘t’ test the calculated‘t’ value is 1.358. The table‘t’ value at 5% level of significance for 28 degrees of freedom is 1.711, which is greater than the calculated ‘t’ value. Hence no significant difference is found between the groups.

- Group A

When the pre-test and post-test values were analyzed by paired‘t’ test, the calculated‘t’ value is 3.83. For 14 degrees of freedom at 5% level of significance the table‘t’ value is 1.761. Since the calculated‘t’ value is greater than the table‘t’ value, the null hypothesis is rejected.

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- Group B

When the pre-test and post-test values were analyzed by paired‘t’ test, the calculated‘t’ value is 3.91. For 14 degrees of freedom at 5% level of significance the table‘t’ value is 1.761. Since the calculated‘t’ value is greater than the table‘t’ value, the null hypothesis is rejected.

- Post-test

The table‘t’ value for 28 degrees of freedom at 5% level of significance is 1.711. The values are analyzed by independent‘t’ test. The calculated‘t’ value is 2.77, which is greater than the table‘t’ value. Hence there is significant difference between the groups.

7. DISCUSSION

Chronic obstructive pulmonary disease pertain to a number of chronic pulmonary conditions, all of which obstruct the flow of air in the respiratory tract and affect ventilation and gas exchange. It affects the activities of daily living of a large proportion of the population.

Physiotherapist uses various airway clearance techniques in the management of airway secretions.

This study was conducted to find the immediate effect of Flutter on pulmonary function in chronic bronchitis patients.

In this study, 30 patients with chronic bronchitis were selected and divided into 2 groups, each group contains 15 patients. Group A received conventional physiotherapy and group B received Flutter along with conventional physiotherapy.

Computerized pulmonary function test was used to measure the outcome measures. Parameters used for data collection are FEV_1 and MVV.

The statistical analysis was done using paired‘t’ test and independent‘t’ test.

The paired‘t’ test analysis showed that there was a statistically significant changes within both the groups.

The improvement could be due to the effect of diaphragmatic breathing exercise, lateral costal expansion and posterior basal expansion & coughing technique. The effects are improved efficiency of ventilation, decreased work of breathing, increased excursion of the diaphragm, improved gas exchange and oxygenation & mobilize lung secretions.[8]

Craig L.Scanlan said that patients with chronic obstructive pulmonary disease, diaphragmatic breathing exercise have been shown to increase the relative contribution of this muscle to ventilation from about 40% to about 67%.

Lateral costal breathing exercises increases mobility of the diaphragm and increases ventilation to the lung bases.[13]

Along with this in experimental group, flutter helps in mucus loosening, mobilization and elimination which reduces the airway obstruction that leads to improvement in pulmonary function.[23]

On statistical analysis using independent‘t’ test between group A and group B showed significant difference in MVV. This could be due to the effect of flutter as a mucus clearance device is based on its ability, to vibrate the airways, intermittently increase endobronchial pressure which helps maintain the patency of the airways during exhalation so that mucus does not become trapped as it moves up the airways and accelerate expiratory airflow which facilitates the upward movement of mucus through the airways so that it can be more easily cleared.

On statistical analysis using independent‘t’ test between group A and group B showed no significant difference in FEV_1. But the mean value of experimental group is greater than control group mean. The lack of significance might be due to the meager sample size and the shorter duration of study.

The result correlates with the study done by **Konstan et al**, who found a large increase in expectorated sputum volume with flutter therapy compared with cough or conventional chest physiotherapy.[23]

Bellone A et al (2000) compared the effectiveness of PEP using flutter device with postural drainage and ELTGOL, concluded that flutter techniques was more effective in secretion removal in chronic bronchitis.[4]

Eaton T et al (2007) suggested that flutter device was well accepted and tolerated airway clearance device and the patient preference was more for flutter device compared to ACBT & postural drainage.[12]

In contrast**, Pryor et al** found that significantly more sputum was produced with the ACBT than with the flutter in individual supervised sessions in patients.[31]

Since flutter device has a significant effect on pulmonary function, it could be implemented in clinical practice to improve the pulmonary function in COPD patients.

8. SUMMARY AND CONCLUSION

Secretion clearance and improvement of pulmonary function is the primary goal in the treatment of COPD patients. Various techniques are used to remove the secretions from the lung.

In order to find the effectiveness of flutter on pulmonary function, it has been conducted with 2 groups, each consists of 15 patients. Group A received conventional physiotherapy and group B received flutter along with conventional physiotherapy for a single day. Pulmonary function test was done using computerized spirometry to measure FEV_1 and MVV. Pre-test and post-test was taken. The statistical analysis using paired‘t’ test at 5% level of significance showed that there is significant improvement in patients of both the groups.

But independent‘t’ test at the 5% level of significance showed that there is no significant difference in MVV.

Based on the outcome results it can be concluded that flutter has immediate effect on pulmonary function and it can be used in the treatment of patients with COPD.

9. LIMITATIONS AND SUGGESTIONS

1. This study has been done with smaller number of patients. Study with a large population is recommended.

2. The study was a short term study, therefore long term study is recommended.

3. Further studies using combination of airway clearance techniques along with flutter, with varying durations and position can be done to obtain maximum therapeutically output.

4. This study only deals with objective measurement. A study which also deals with subjective measures such as dyspnea is recommended.

5. Measurement tools used in the study to measure pulmonary function were computerized pulmonary function test [FEV_1 & MVV]. Other measurements criteria like PEFR, arterial oxygen saturation, respiratory rate, heart rate, and sputum volume can also be included.

BIBLIOGRAPHY

1. Alexander Hough, Physiotherapy in respiratory care: An evidence based approach to respiratory and cardiac management. 3rd edition.pg no. 201.
2. Ambrosino N, Callgari G, Galloni C et al. Clinical evaluation of oscillating positive expiratory pressure for enhancing expectoration in diseases other than cystic fibrosis. Monaldi Arch Chest Disease 1995; 50(4):269-75.
3. Balgburm M. comparison of flutter with percussion in stable cystic fibrosis patients. Am J Resp Crit Care Med. 1995: pg 639.
4. Barbara A. Webber; Physiotherapy for respiratory and cardiac problems; 3rd edition 2001:158-159.
5. Bellone A, Lascioli R, Raschi S, et al. Chest physical therapy in patients with acute exacerbations of chronic bronchitis, effectiveness of three methods. Arch Phys Med Rehabilitation. May 2000; 81:558-60.
6. Brook D et al: The flutter device of expiratory pressures. Journal of cardio Pulmonary Rehabilitation 2002 Jan; 22(1):53-7.
7. Burioka N, Sugimoto Y, Suyama H, et al. Clinical efficacy of the flutter device for airway mucus clearance in patients with diffuse panbronchitis.Respirology1998; 3: 183-186.
8. Carolyn C et al: Comparison of chest physiotherapy, flutter and PEP – Downers Grove, il 60515.

9. Carolyn Kisner, Lynn Allen Colby: Therapeutic exercise, Foundations and Techniques, 3rd edition; 665-667.
10. Casaulta Aebischer C, Frey U , Schibler A ,Kraemer R. Efficiency of chest physiotherapy (PEP mask versus flutter) in patients with cystic fibrosis. Euro Respir J 1993; 6: 220S.
11. Cegla UH, Retzow A. Physiotherapy with the VRPI for chronic obstructive pulmonary disease: results of a multicenter comparative study. Pneumologise 1993; 47:636-9.
12. Eaton T, Young P, Zeng I, Kolbe J. A randomized evaluation of the acute efficacy, acceptability of flutter and active cycle of breathing with and without postural drainage in non – cystic fibrosis. Chron Respir Dis. 2007; 4(1):23-30.
13. Egan's-Fundamentals of respiratory care, Craig L.Scanlan; 6th edition 1995:769 -771,788-89.
14. Elizabeth Dean, Donna Frownfelter. Cardiovascular and pulmonary physical therapy, Evidence and practice. 4th edition Elsevier, 2000: 328.
15. Ellen A. Hillegass, H Steven Sadowsky; Essentials of cardiopulmonary physiotherapy; W.B. Saunders publications; 1993: 257.
16. Global initiative for COPD. Global strategy for the diagnosis management and prevention of COPD 2003.www.goldcopd.com.

17. Gold Workshop report 2005 update, Global strategy for the diagnosis, management and prevention of COPD: www.gold.copd.org.
18. Gondar M, Nixon PA, Mutich R, et al .Comparison of flutter device and chest physical therapy in the treatment of cystic fibrosis pulmonary exacerbation. Pediatric pulmonology 1999; Oct; 28(4): 255-60.
19. Gosselink RAM, Wagenar RC, Rijswijk H, Sargeant AJ. Diaphragmatic breathing reduces efficiency of breathing in patients with COPD. Am J Respir Crit Care Med 1995; 151: 1136-1142.
20. Halbart RJ, Isonaka S, Interpreting COPD prevalence estimates: What is the true burden of disease? Chest: 123: 1684-1692.
21. Homnick DN, Anderson K, Marks JH. Comparison of the flutter device to standard chest physiotherapy in hospitalized patients with cystic fibrosis. A pilot study. Chest 1998; 114: 993-7.
22. Joanne Watchie: Cardiovascular and pulmonary physical therapy 2nd edition; 14-15, 324-326.
23. King M, Rubin BK. Mucus physiology and pathophysiology in; Derenne JP. Acute Respiratory failure in COPD. New York, Dekker 1996; 391-405.
24. Konstan MW, Stern RC, Doershuk CF. Efficacy of the flutter device for airway mucous clearance in patients with cystic fibrosis. Pediatrics; May 1994; 124: 689-93.

25. Lindemann H. The value of physical therapy with VRPI Destin. Pneumologise 1992; 46: 626-30.
26. Lyons E, Chatham K, Campbell IA, Prescott RJ. Evaluation of the flutter VRPI device in young adults with cystic fibrosis. Med Sci Res 1993; 21: 101-102.
27. Manday smith, Vall ball: Cardio vascular and respiratory physiotherapy.
28. Mcllwaine PM, Wong LTK, Peacock D, et al. Long term comparative trial of positive expiratory pressure versus positive expiratory pressure[flutter] physiotherapy in the treatment of cystic fibrosis. Pediatric 2001; 138: 845-50.
29. Nakamura S et al. acute effect of use of the flutter on expectorations of sputum in patients with chronic respiratory disease. Nihon Kyobu Shikkam Gakkai Zashi. 1996 Feb; 34(2):180-5.
30. Pike SE et al; Comparison of flutter VRPI and forced expiration with ACBT in subjects with cystic fibrosis. Netherlands Journal of Medicine 54:555-56
31. Pryor JA et al .Physical therapy for adults with bronchiectasis obstructive airway disease. Clinical Pulmonary Medicine: 11[4]: 201-209; July 2009.
32. Pryor JA, Webber BA, Hodson ME et al. The flutter VRPI valve as an adjacent to chest physiotherapy in cystic fibrosis. Respir Med 1994; 88: 677-81.

33. Rossman CM, Waldes R, Sampson D. effect of chest physiotherapy on the removal of mucus in patients with cystic fibrosis. Am Rev Respir Dis. 1982 Jul; 126(1):131-5.

34. Scot Irwin M.S.P.T. Cardiac Pulmonary Physical Therapy; pg: 359, 267-269, 380.

35. Smibi Skaria, Arul Joseph, Jasobanta Sethi. Effect of positive expiratory pressure technique over forced expiratory technique on bronchial hygiene in patients with moderate chronic bronchitis. Journal of Physiotherapy and Occupational therapy. July-sep 2008; vol 2, no.3.

36. Susan B O'Sullivan, Thomas J Schmitz: Physical Rehabilitation.5th edition; pg no: 581,957.

37. Sutton PP, Parker RA, Webber BA, et al. Assessment of the forced expiration technique, postural drainage and directed coughing in chest physiotherapy. Eur J Respir Dis 1983; 64: 62-68.

38. Sharon M.H.Tsang, Alice Y.M.Jones et al. Postural drainage or flutter device in conjunction with breathing and coughing compared to breathing and coughing alone in improving secretion removal and lung function in patients with acute exacerbation of bronchiectasis: A pilot study.

Department of rehabilitation sciences, the Hong Kong Polytechnic University, 13 July 2009.

39. Thompson CS, Harrison S, Ashley J, Day K, Smith DL. Randomized crossover study of the flutter device and the active cycle of breathing technique in non-cystic fibrosis. Thorax 2002; 57: 446-448.
40. U.S. Department of health and human services-2000.
41. US Surgeon General (1984), The Health consequences of smoking; chronic obstructive lung disease. Pub No.84-50205, Washington, D.C: US Department of Health and human resources.
42. Van Winden C.M.Q, Visser. A, Sterk .P et al. Effects of flutter and PEP mask physiotherapy on symptoms and lung function in children with cystic fibrosis. Eur Respir J 1998; 12: 143-147.
43. Vitacca M, Clini. E, Bianchi.L, Ambrosino.N.Acute effects of deep diaphragmatic breathing in COPD patients with chronic respiratory insufficiency. Eur Respir J 1998; 11: 408-415.
44. Weiner et al: Physiotherapy in COPD; Oscillatory breathing with flutter VRPI. Harefuah 1996, July: 131(1-2): 14-7, 71.
45. Williams IP, Smith M, Mc Gavis CR. Diaphragmatic breathing training and walking performance in chronic airways obstruction. Brazilian Journal Disease Chest 1982; 76; 164-166.

46. Wolkove. N et al; A randomized trial to evaluate the sustained efficacy of a mucus clearance device in ambulatory patient with COPD. Cardio Respiratory Journal 2004 Nov; 11(8); 567-72.
47. World Health Organization, World Health Report 2002 Geneva: WHO, 2002.www.who /int/whr/2002/en/.

APPENDIX I

INFORMED CONSENT TO PARTICIPATE IN THE RESEARCH STUDY

I _____ voluntarily consent to participate in the research study, "IMMEDIATE EFFECT OF FLUTTER ON PULMONARY FUNCTION IN CHRONIC BRONCHITIS PATIENTS"- An Experimental Study.

The researcher has explained me about the research in brief, the risk of participation and has answered the questions related to the research to my satisfaction.

Signature of the applicant: **Signature of the researcher:**

Signature of the witness:

APPENDIX II

ASSESSMENT FORM

Patient profile

Name:

Age:

Sex:

Occupation:

Address:

Diagnosis:

Chief complaints:

Present medical history:

Personal history:

Assessment data:

Computerized pulmonary function test:

S.No	Parameters	Pre -test	Post -test
1.	FEV_1		
2.	MVV		